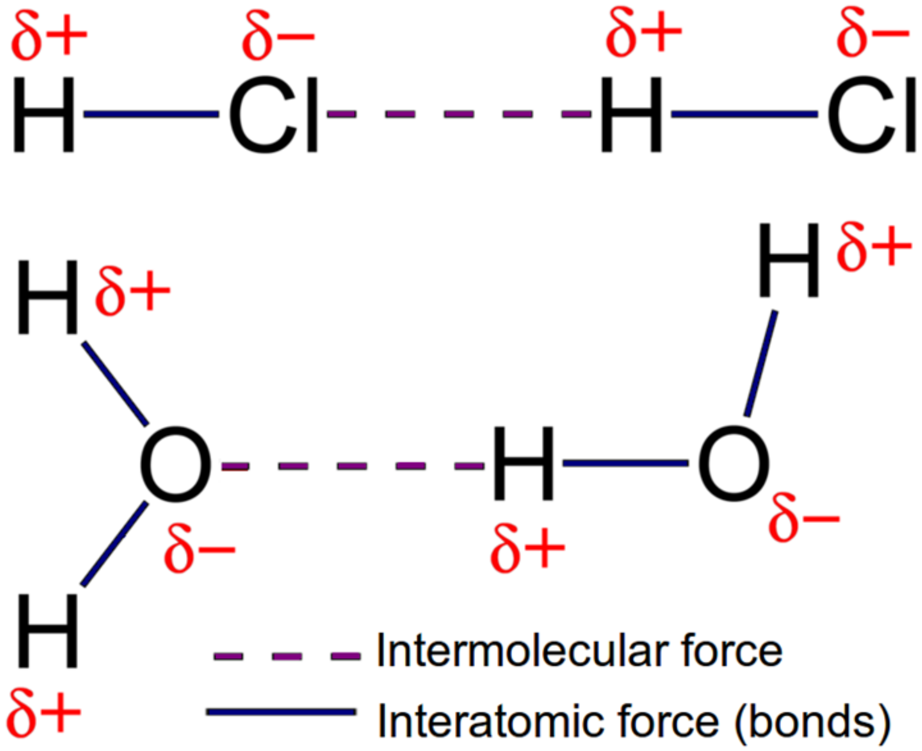
Interatomic forces are the forces that hold the atoms in molecules together. The thermal behavior of a solid material is controlled by the interatomic forces through the vibrational spectrum of the crystal lattice.

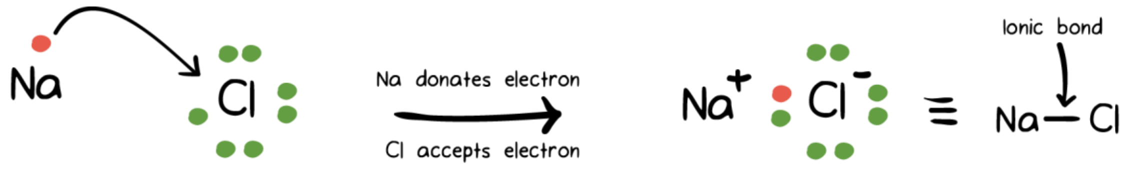
The interatomic forces are active if the distance between the two atoms is of the order of atomic size ≈ 10 m. In the case of molecules, the range of the force is of the order of 10-9 m.

Covalent molecules have covalent bonds between their atoms. Intermolecular forces occur between molecules and do not involve individual atoms. Interatomic forces are the forces that hold the atoms in molecules together& a mutual attraction between two atoms resulting from a redistribution of their outer electrons. Interatomic force is arising due to the electrostatic interaction between the nuclei of two atoms their electron clouds and between the nucleus of one atom and the electron cloud of the other atom.



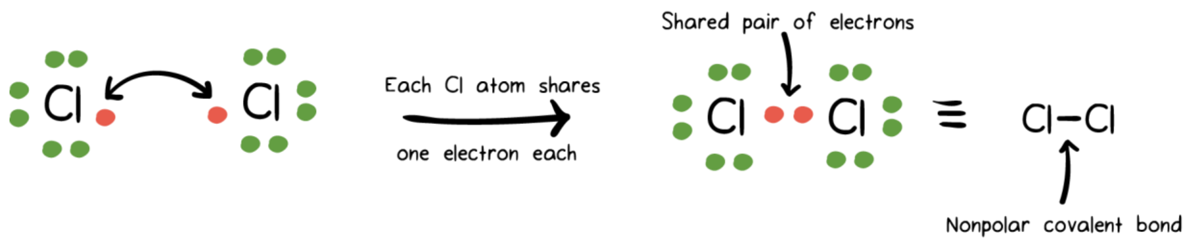
Types of interatomic forces

Ionic bond: This bond is formed by the complete transfer of valence electron(s) between atoms. It is a type of chemical bond that generates two oppositely charged ions. In ionic bonds, the metal loses electrons to become a positively charged cation, whereas the nonmetal accepts those electrons to become a negatively charged anion.

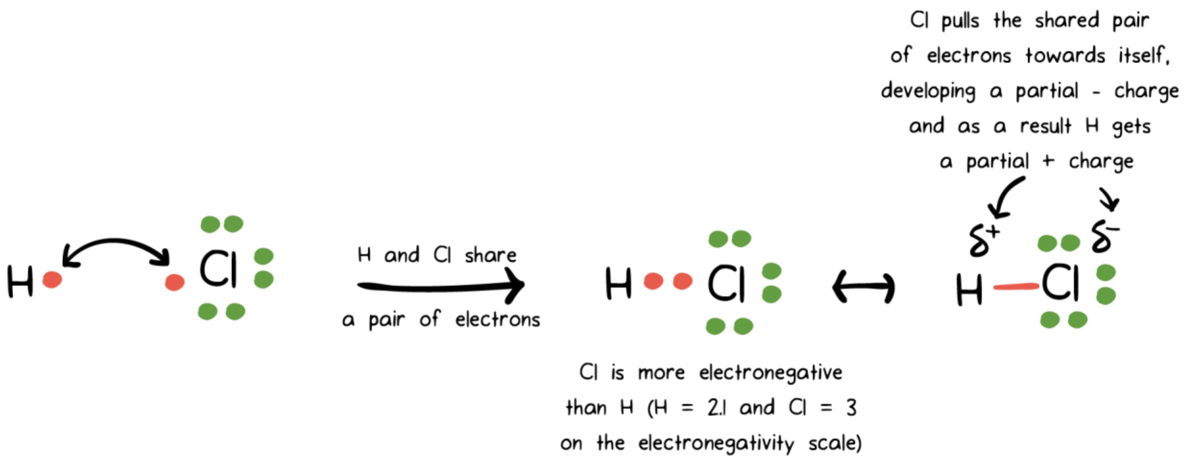


Covalent bond: This bond is formed between atoms that have similar electronegativities—the affinity or desire for electrons. Because both atoms have similar affinity for electrons and neither has a tendency to donate them, they share electrons in order to achieve octet configuration and become more stable.

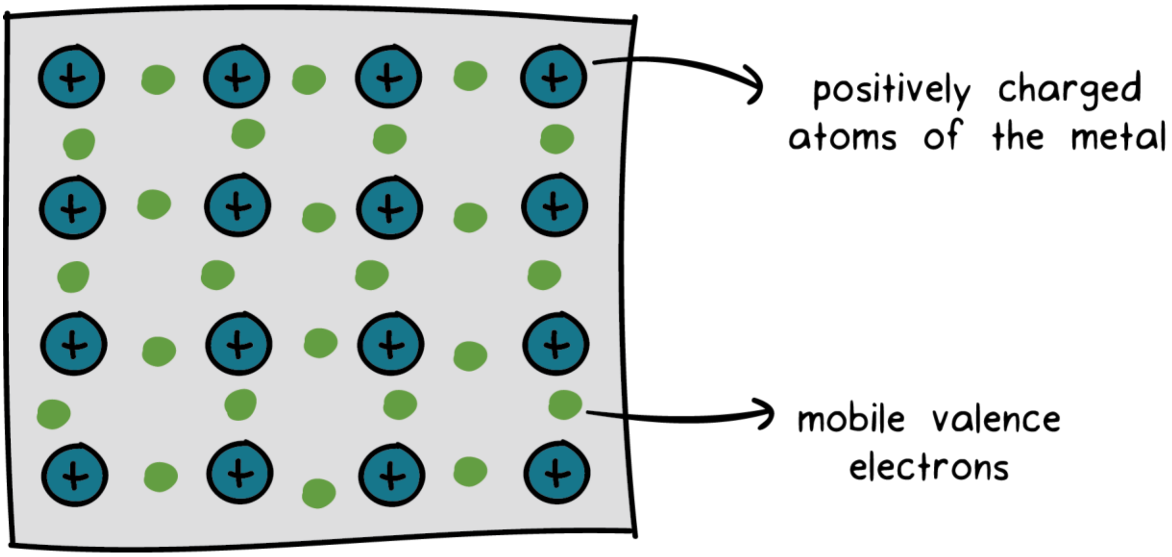
- A nonpolar covalent bond is formed between same atoms or atoms with very similar electronegativities—the difference in electronegativity between bonded atoms is less than 0.5.



- A polar covalent bond is formed when atoms of slightly different electronegativities share electrons. The difference in electronegativity between bonded atoms is between 0.5 and 1.9. Hydrogen chloride {HCl}; the O – H bonds in water, H2O; and hydrogen fluoride, HF are all examples of polar covalent bonds.



Metallic bonding: This type of covalent bonding specifically occurs between atoms of metals, in which the valence electrons are free to move through the lattice. This bond is formed via the attraction of the mobile electrons—referred to as sea of electrons—and the fixed positively charged metal ions. Metallic bonds are present in samples of pure elemental metals, such as gold or aluminum, or alloys, like brass or bronze.



The freely moving electrons in metals are responsible for their reflecting property—freely moving electrons oscillate and give off photons of light—and their ability to effectively conduct heat and electricity.

Electrostatic force:

The electrostatic force is an attractive and repulsive force between particles are caused due to their electric charges. The electric force between stationary charged body is conventionally known as the electrostatic force. It is also referred to as Columb's force.

The electrostatic force in an atom holds electrons and protons together in atoms and allows the atoms of different elements to bond together to form new substances. It is also responsible for the solidity of solid objects.

Interatomic Electrostatic force:

When metals and nonmetals form compounds, the metal atoms donate electrons to the nonmetal atoms. The metal atoms become positive ions due to their loss of negatively charged electrons, and the nonmetal atoms become negative ions. Ions exhibit attractive forces for ions of opposite charge -- hence the adage that "opposites attract." The force of attraction between oppositely charged ions follows Coulomb's law: F = k * q1 * q2 / d2, where F represents the force of attraction in Newtons, q1 and q2 represents the charges of the two ions in coulombs, d represents the distance between the ions' nuclei in meters and k is a proportionality constant of 8.99 x 109 Newton square meters per square coulomb.

Theoretical Analysis

Chemical formulas, by convention, list the positive ion first. In the compound calcium bromide, or CaBr2, for example, the calcium represents the positive ion and exhibits a charge of +2. Bromine represents the negative ion and exhibits a charge of -1. Therefore, q1 = 2 and q2 = 1 in the Coulomb's law equation.

Convert the charges on the ions to coulombs by multiplying each charge by 1.9 x 10-19. The +2-calcium ion therefore exhibits a charge of 2 * 1.9 x 10-19 = 3.8 x 10^{-19} coulombs, and bromine exhibits a charge of 1.9 x 10^{-19} coulombs.

Determine the distance between the ions. When they form solids, ions normally sit as close to each other as possible. The distance between them is found by adding together the radii of the positive and negative ions. In the example calcium bromide, Ca2+ ions exhibit a radius of about 231pm and Br- ions exhibit a radius of about 185pm. The distance between their nuclei is therefore 231+185=416pm

Convert the distance between the ions' nuclei to units of meters by multiplying the value in picometer by 1 x 10^{-12}. Continuing the previous example, the distance of 416pm converts to 4.16 x 10^{-10} meters.

Calculate the force of attraction according to F = k * q1 * q2 / d2.

Using the previously obtained values for calcium bromide and using 8.99 x 10^{9} as the value for k gives F = (8.99 x 10^{9}) * (3.8 x 10^{-19}) * (1.9 x 10^{-19}) / (4.16 x 10^{-10})^{2}. Under the rules of the scientific order of operations, the squaring of the distance must be carried out first, which gives F = (8.99 x 10^{9}) * (3.8 x 10^{-19}) * (1.9 x 10^{-19}) / (17.30x 10^{-20}). Performing the multiplication and division then gives F = 0 N/C This value represents the force of attraction between the atoms.